

Claims

What is claimed is:

1. An image capture and projection apparatus for use in an electronic whiteboard system, the apparatus comprising:

5 an image capture device, the image capture device tracking a position of at least one stylus associated with the electronic whiteboard system used to enter data in accordance with a surface associated with the electronic whiteboard system; and

 an image projection device, the image projection device projecting an image which is viewable on the surface, in proximity of the position of the stylus, and
10 representative of the data entered in accordance with the stylus, wherein the image capture device and the image projection device share at least one imaging lens for capturing and projecting one or more images.

2. The apparatus of claim 1, wherein the image capture device and the image projection device are physically integrated with one another to form an integrated image
15 capture/projection device.

3. The apparatus of claim 2, wherein the integrated image capture/projection device is a front-projection type device.

4. The apparatus of claim 2, wherein the integrated image capture/projection device is a rear-projection type device.

20 5. The apparatus of claim 2, wherein an image projection portion of the integrated image capture/projection device is a transmissive liquid crystal-based lightvalve type device.

6. The apparatus of claim 2, wherein an image projection portion of the integrated image capture/projection device is a reflective liquid crystal-based lightvalve type device.

7. The apparatus of claim 2, wherein an image projection portion of the integrated image capture/projection device is a digital micromirror deflection type device.

5 8. The apparatus of claim 2, wherein an image capture portion of the integrated image capture/projection device comprises a charge coupled device.

9. The apparatus of claim 8, wherein the charge coupled device is an infrared charge coupled device.

10 10. The apparatus of claim 9, wherein the image capture portion further comprises an infrared-reflecting, visible-transmitting cube for: (i) reflecting infrared light received through the imaging lens from the proximity of the stylus; and (ii) passing visible light produced by an image projection portion of the integrated device through to the imaging lens for presentation on the surface of the electronic whiteboard surface.

15 11. The apparatus of claim 10, wherein the image capture portion further comprises an infrared-transmitting, visible-blocking filter for: (i) passing infrared light reflected by the infrared-reflecting, visible-transmitting cube to the infrared charge coupled device; and (ii) blocking visible light.

20 12. The apparatus of claim 11, wherein the image capture portion further comprises an infrared refocusing lens positioned between the infrared-reflecting, visible-transmitting cube and the infrared-transmitting, visible-blocking filter.

13. The apparatus of claim 11, wherein the infrared charge coupled device records the infrared light received from the proximity of the stylus via the imaging lens, the infrared-reflecting, visible-transmitting cube, the infrared refocusing lens and the infrared-transmitting, visible-blocking filter.

5 14. The apparatus of claim 9, wherein an image projection portion and the image capture portion of the integrated device share a dichroic X-cube having an infrared-reflecting interface for: (i) combining components of visible light produced by the image projection portion and passing them through to the imaging lens for presentation on the surface of the electronic whiteboard surface; and (ii) reflecting
10 infrared light received through the imaging lens from the proximity of the stylus.

 15. The apparatus of claim 14, wherein an image projection portion and the image capture portion of the integrated device share a polarizing beam splitter having an infrared-reflecting coating for: (i) polarizing a component of visible light produced by the image projection portion; and (ii) reflecting infrared light received from the infrared
15 reflecting interface of the dichroic X-cube.

 16. The apparatus of claim 15, wherein the image capture portion further comprises an infrared-transmitting, visible-blocking filter for: (i) passing infrared light reflected by the infrared-reflecting coating of the polarizing beam splitter to the infrared charge coupled device; and (ii) blocking visible light.

20 17. The apparatus of claim 16, wherein the infrared charge coupled device records the infrared light received from the proximity of the stylus via the imaging lens, the infrared-reflecting interface of the dichroic X-cube, the infrared-reflecting coating of the polarizing beam splitter and the infrared-transmitting, visible-blocking filter.

18. The apparatus of claim 9, wherein an image projection portion and the image capture portion of the integrated device share a total internal reflection prism having an infrared-reflecting coating for: (i) passing visible light produced by the image projection portion in accordance with a deflection micromirror device through to the imaging lens for presentation on the surface of the electronic whiteboard surface; and (ii) reflecting infrared light received through the imaging lens from the proximity of the stylus.

19. The apparatus of claim 18, wherein the image capture portion further comprises an infrared-transmitting, visible-blocking filter for: (i) passing infrared light reflected by the infrared-reflecting coating of the total internal reflection prism to the infrared charge coupled device; and (ii) blocking visible light.

20. The apparatus of claim 19, wherein the infrared charge coupled device records the infrared light received from the proximity of the stylus via the imaging lens, the infrared-reflecting coating of the total internal reflection prism and the infrared-transmitting, visible-blocking filter.

21. The apparatus of claim 2, wherein the integrated image capture/projection device is self-aligning.

22. The apparatus of claim 2, wherein the integrated image capture/projection device is dynamically zoomable.

23. An electronic whiteboard system, the system comprising:
a data entry surface;
at least one stylus for entering data in accordance with the data entry surface;

an image capture device, the image capture device tracking a position of the stylus while the stylus is used to enter data in accordance with the data entry surface; and

an image projection device, the image projection device projecting an image which is viewable on the surface, in proximity of the position of the stylus, and
5 representative of the data entered in accordance with the stylus, wherein the image capture device and the image projection device share at least one imaging lens for capturing and projecting one or more images.

24. An active optical marker device for use in accordance with an electronic whiteboard system, the electronic whiteboard system including a data entry surface, an
10 image capture device for tracking a position of the optical marker device while the optical marker device is used to enter data in accordance with the data entry surface, and an image projection device for projecting an image which is viewable on the surface, in proximity of the position of the optical marker device, and representative of the data entered in accordance with the optical marker device, the active optical marker device
15 comprising:

an infrared light-emitting source; and

a switch, operatively connected to the infrared light source, and operative to turn on the infrared light source when the optical marker device contacts the surface and turn off the infrared light source when the optical marker device does not contact the surface,
20 such that the image capture device can capture the infrared light emitted by the optical marker device and the image projection device can project the representative image on the surface.

25. The device of claim 24, wherein the infrared light-emitting source is directed toward the image capture device.

26. The device of claim 24, wherein the surface is a reflective surface and further wherein the infrared light-emitting source is directed toward the surface.

27. The device of claim 24, further comprising a low-friction nib connected to the switch, the nib contacting the surface when data is being entered.

5 28. A passive optical marker system for use in accordance with an electronic whiteboard system, the electronic whiteboard system including a data entry surface, an image capture device and an image projection device, the passive optical marker system comprising:

 an infrared-emitting light source for illuminating the data entry surface; and

10 an infrared light reflector having a low-friction glide and a non-isotropic surface, the reflector being worn by a user such that the low-friction glide comes into contact with the surface when the user enters data and, in accordance with such data entry, infrared light emitted by the source is reflected from the reflector to the image capture device, such that the image capture device can capture the reflected infrared light and track a
15 position of the reflector, and such that the image projection device can project an image which is viewable on the surface, in proximity of the position of the reflector, and representative of the data entered in accordance with the reflector on the surface.

29. The system of claim 28, wherein the non-isotropic surface of the reflector is unique as compared to other reflectors.